



MARKSCHEME

November 2009

BIOLOGY

Higher Level

Paper 2

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General Marking Instructions

Subject Details: Biology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**32 marks**] and **TWO** questions in Section B [**2 × 20 marks**]. Maximum total = [**72 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded.
9. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:
 - expression of relevant ideas with clarity
 - structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (e.g. within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

SECTION A

1. (a) 200% [1]
- (b) IDE $-/-$ mice do not have the enzyme to break down insulin; (*accept converse*)
therefore insulin levels higher in IDE $-/-$ mice / lower in IDE $+/+$ mice; [2]
- (c) in IDE $+/+$ mice, glucose (levels in the blood) peaks / starts to reduce after 30 minutes /
in IDE $-/-$ mice, glucose levels remain high for longer / continues to rise for 60 minutes;
blood glucose level is always higher in IDE $-/-$ mice than in IDE $+/+$ mice / blood
glucose level in IDE $+/+$ mice decreases rapidly to original level but remains high in
IDE $-/-$ mice ; [2]
- (d) both blood glucose and insulin levels are higher in IDE $-/-$ mice / high blood
glucose levels and insulin levels are seen in type II diabetes;
due to this, IDE $-/-$ mice are a good model for type II diabetes; [2]

*(to award this mark answer
needs justification)*
- (e) (in both cases) when insulin is present control mice are better at taking up glucose
than MIRKO mice;
no insulin receptors in skeletal muscle of MIRKO mice; (*accept converse*) [2]
- (f) exercise increases glucose uptake more than insulin [1]
Award [0] for simply just restating figures.
- (g) exercise stimulates glucose uptake into muscle / exercise lowers blood glucose;
exercise is more effective in reducing blood glucose in MIRKO mice (than in
control mice);
exercise and insulin combined are more effective in both (MIRKO and control) mice;
exercise combined with insulin would be an appropriate therapy; [3 max]
- (h) *cells:* β cells (in islets of Langerhans);
organ: pancreas; [2]
- (i) glucagon / adrenaline / cortisol [1]

2. (a) active immunity is by the production of antibodies by the body and passive immunity is when antibodies are obtained from an external source;
in active immunity the individual is exposed to the antigen/pathogen/has the disease and in passive immunity the individual is not exposed;
active immunity gives rise to memory cells and passive immunity does not; [2 max]
- (b) B lymphocytes are produced in laboratory animal after injection with an antigen;
animal cells/these cells are fused with tumour cells (to form hybridomas which) produce antibodies; [2]
- (c) HIV virus transmitted by body secretions/semen/blood/across placenta;
transmitted by infected blood transfusions/intravenous drug users;
mainly by sexual activity/promiscuity; [2 max]
- (d) antibiotics block metabolic pathways / work only on bacteria;
viruses reproduce using their hosts' metabolic pathways / do not have their own metabolic pathways; [2]
3. (a) genes that are located on the same chromosome (form a linkage group) [1]
- (b)
$$\frac{G \ f}{g \ f};$$

$$\frac{g \ F}{g \ f};$$
 [2]
Award [1 max] if the candidate does not use the same format, but gives the correct letters Ggff and ggFf.
- (c) (recombination) occurs in prophase 1 of meiosis;
homologous chromosomes come together in pairs;
chiasmata form between the (non-sister) chromatids;
chromosomes exchange segments / crossing over takes place; [3 max]
- (d) tRNA attaches to (specific) amino acid;
tRNA (with amino acid) moves to the ribosome;
anticodon of tRNA binds with codon of mRNA; [2 max]

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

4. (a) Award **[1]** for each structure clearly drawn and correctly labelled.
 cell wall – with some thickness;
 plasma membrane – shown as single line or very thin;
 cytoplasm;
 pilus/pili – shown as single lines;
 flagellum/flagella – shown as thicker and longer structures than pili and embedded in cell wall;
 70S ribosomes;
 nucleoid / naked DNA;
 approximate width $0.5\ \mu\text{m}$ / approximate length $2.0\ \mu\text{m}$; **[5 max]**
 Award **[4 max]** if the bacterium drawn does not have the shape of a bacillum (rounded-corner rectangle with length approximately twice its width).
 Award **[4 max]** if any eukaryotic structures included.

(b)

passive	active
diffusion / osmosis / facilitated diffusion	active transport / ion pumps / exocytosis / pinocytosis / phagocytosis
a second passive method (<i>from above</i>)	a second active method; (<i>from above</i>)
does not require energy	requires energy/ATP;
down concentration gradient	against concentration gradient;
no pumps needed	requires protein pumps;
oxygen across alveoli / other example	glucose absorption in ileum / other example;

[4 max]

Both the passive and active movements must be contrasted to receive a mark.
 Award **[3 max]** if no examples are given. Responses do not need to be shown in a table format.

- (c) occurs during aerobic respiration;
 oxidative phosphorylation occurs during the electron transport chain;
 hydrogen/electrons are passed between carriers;
 releasing energy;
 finally join with oxygen (to produce water);
 occurs in cristae of mitochondria;
 chemiosmosis is the movement of protons/hydrogen ions;
 protons move/are moved against their concentration gradient;
 into the space between the two membranes;
 protons flow back to the matrix;
 through the ATP synthase/synthetase (enzyme);
 energy is released which produces more ATP/combines ADP and P_i ; **[9 max]**

(Plus up to **[2]** for quality)

5. (a) *Award [1] for each structure clearly drawn and correctly labelled.*
Sarcomere – clearly indicated between Z lines;
Z lines;
actin filaments attached to Z line;
myosin filaments with heads;
(two) light bands;
dark band; *[4 max]*
- (b) calcium ions are released from the sarcoplasmic reticulum;
they expose the myosin binding sites (on actin) / cause movement of blocking molecules/troponin;
cross-bridges form between actin and myosin molecules;
ATP provides energy;
for actin filaments to slide over the myosin filaments / for myosin to push actin;
ATP provides energy to release myosin from binding site;
action can be repeated further along the molecule; *[5 max]*
- (c) the resting potential of cell is negative inside compared with outside;
stimulation causes depolarization/reversal of charge on each side;
due to Na^+ channels opening / Na^+ flowing into the cell;
which causes an action potential;
 K^+ channels open / K^+ flows out of the cell;
sodium potassium pump restores resting potential;
transmitted between neurons across a synapse;
neurotransmitter released into synaptic cleft;
diffuse across cleft to postsynaptic membrane;
where they bind to receptors;
influx of Na^+ into cell;
which may initiate action potential; *[9 max]*

(Plus up to [2] for quality)

6. (a) x-axis (time) and y-axis (number in population/of individuals) { (do not accept correctly labelled; growth on y-axis)
S curve correctly drawn;
lag phase;
exponential/log phase;
population growth slowing down / transitional phase / environmental resistance;
plateau phase; [4 max]
To award marks phases must be labelled not just drawn. Award [3 max] if no axes shown.
- (b) production of sperm/spermatozoa in the testes/seminiferous tubules;
first stage of sperm production requires divisions by mitosis;
cells then undergo a period of growth;
future sperm cells then undergo two meiotic divisions;
cells then differentiate to form sperm cells;
nourished by Sertoli cells
number becomes haploid / chromosome number halved / 46 to 23 chromosomes; [5 max]
- (c) embryonic/disc shaped structure that nourishes the developing embryo;
starts forming at implantation of the blastocyst/embryo;
embryonic tissue invades/grows into the uterine wall;
fetal capillaries exchange material with maternal blood/lacunae;
allows exchange of food/oxygen/antibodies from mother's blood to fetus;
allows exchange of carbon dioxide/waste products from fetal blood to mother;
connected to the embryo/fetus by an umbilical cord;
placenta takes over hormonal role of ovary;
indication of time this happens / at approximately 12 weeks;
secretes estrogen/progesterone;
hormone secretion maintains pregnancy;
expelled from uterus after childbirth; [9 max]

(Plus up to [2] for quality)

7. (a) water has a high specific heat capacity;
a large amount of heat causes a small increase in temperature;
water has a high latent heat of vaporization;
a large amount of heat energy is needed to vaporize/evaporate water;
hydrogen bonds between water molecules make them cohesive/stick together;
this gives water a high surface tension / explains how water rises up xylem;
water molecules are polar;
this makes water a good solvent; **[5 max]**
Award [4 max] if thermal, cohesive and solvent properties are not all mentioned.
- (b) xerophytes are plants that live in dry conditions;
reduced leaves/spines to prevent water loss (by transpiration);
rolled leaves to prevent water loss / stomata on the inside / sunken stomata;
thick waxy cuticle/hairs on leaves to prevent water loss (by transpiration);
reduced stomata to prevent water loss (by transpiration) / stomata on one side of leaf;
deep/widespread roots to obtain more water;
special tissue for storing water;
take in carbon dioxide at night / CAM plant to prevent water loss; **[4 max]**
- (c) process of water balance is called osmoregulation;
water passes into the kidney tubules by ultrafiltration;
water is reabsorbed in the proximal convoluted tubule;
water reabsorbed into blood from the (descending limb) of the loop of Henle;
process by osmosis;
transport of salts into the medulla of kidney;
changes salt concentration so water is reabsorbed;
ADH released into blood when water is required;
ADH causes concentrated urine / no/low ADH causes dilute urine;
this causes more reabsorption of water from the collecting duct;
excess water is released as urine;
urine concentration depends on the body's need for water;
drinking a lot gives dilute urine; **[9 max]**

(Plus up to [2] for quality)
